INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/00614

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04B 7/05, H04Q 7/38, H04Q 7/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04B, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9807291 A2 (NOKIA TELECOMMUNICATIONS OY), 19 February 1998 (19.02.98), see whole document	1,18
A	US 5905733 A (TORBJÖRN WILSON SÖLVE ET AL), 18 May 1999 (18.05.99), see whole document	1,18

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search	Date of mailing of the international search report
20 October 2000	2 4 -10- 2000
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Bo Gustavsson/MN Telephone No. +46 8 782 25 00

Patent document cited in search report			Publication date	Patent family member(s)			Publication date
WO	9807291	A2	19/02/98	AU	722325	B	27/07/00
				AU	3772197	A	06/03/98
				CN	1227700	A	01/09/99
				EP	0976285	A	02/02/00
				FI	101760	B	00/00/00
				FI	963136	A	10/02/98
				NO	990569	A	08/02/99
US	5905733	A	18/05/99	AU	5513698	A	29/06/98
				WO	9825356	A	11/06/98

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T299035PC/nu

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0-1	For receiving Office use only International Application No.	**PCT/FI 0 0 / 0 0 6 1 4**
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0-3	Name of receiving Office and "PCT International Application"	**The Finnish Patent Office PCT International Application**

0-4	Form - PCT/RO/101 PCT Request	
0-4-1	Prepared using	**PCT-EASY Version 2.90 (updated 10.05.2000)**
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	**National Board of Patents and Registration (Finland) (RO/FI)**
0-7	Applicant's or agent's file reference	**T299035PC/nu**
I	Title of invention	**METHOD OF IDENTIFYING INFORMATION ADDRESSED TO A USER IN A COMMUNICATION SYSTEM, AND A COMMUNICATION SYSTEM**
II	Applicant	
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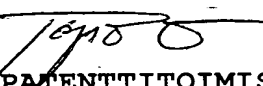| III-2	Applicant and/or inventor	
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V	Designation of States	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AP: GH GM KE LS MW MZ SD SL SZ TZ UG ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT OA: BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT

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V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AE AG AL AM AT (patent and utility model) AU AZ BA BB BG BR BY BZ CA CH&LI CN CR CU CZ (patent and utility model) DE (patent and utility model) DK (patent and utility model) DM DZ EE (patent and utility model) ES FI (patent and utility model) GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR (patent and utility model) KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK (patent and utility model) SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW
V-5	**Precautionary Designation Statement** In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.	
V-6	**Exclusion(s) from precautionary designations**	NONE
VI-1	**Priority claim of earlier national application**	
VI-1-1	Filing date	05 July 1999 (05.07.1999)
VI-1-2	Number	991534
VI-1-3	Country	FI
VI-2	**Priority document request** The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s):	VI-1
VII-1	**International Searching Authority Chosen**	Swedish Patent Office (ISA/SE)

VIII	Check list	number of sheets	electronic file(s) attached
VIII-1	Request	4	—
VIII-2	Description	16	—
VIII-3	Claims	5	—
VIII-4	Abstract	1	t299035p.txt
VIII-5	Drawings	7	—
VIII-7	TOTAL	33	
	Accompanying items	paper document(s) attached	electronic file(s) attached
VIII-8	Fee calculation sheet	✓	—
VIII-9	Separate signed power of attorney	✓	—
VIII-10	Copy of general power of attorney	✓	—
VIII-16	PCT-EASY diskette	—	diskette

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VIII-18	Figure of the drawings which should accompany the abstract	1B
VIII-19	Language of filing of the international application	English
IX-1	Signature of applicant or agent	⟨signature⟩ Tapio Äkräs
IX-1-1	Name	PATENTTITOIMISTO TEKNOPOLIS KOLSTER OY

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10-1	Date of actual receipt of the purported international application	0 4 JUL 2000 (0 4 -07- 2000)
10-2	Drawings:	
10-2-1	Received	
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/SE
10-6	Transmittal of search copy delayed until search fee is paid	

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| 11-1 | Date of receipt of the record copy by the International Bureau | |

(54) Title: METHOD OF IDENTIFYING INFORMATION ADDRESSED TO A USER IN A COMMUNICATION SYSTEM, AND A COMMUNICATION SYSTEM

(57) Abstract: The invention relates to a method of identifying information addressed to a user in a communication system, and to a communication system comprising at least one transmitter (120) and at least one receiver (UE), in which communication system the transmitter (120) is arranged to transmit on a shared channel (312) data packets (330A to 330D) provided with a training sequence (300), on which channel two or more receivers (UE) are arranged to receive said data packets (330A to 330D), and the receiver (UE) is arranged to generate a channel estimate on the basis of the training sequence (300). The communication system is arranged to provide the data packets (330A to 330D) addressed to different receivers (UE) or receiver groups with different training sequences (300), the receiver (UE) is arranged to identify and further process the data packets (330A to 330D) addressed to the receiver (UE) and whose training sequence (300) the receiver (UE) identifies, and the receiver (UE) is arranged to ignore the data packets (330A to 330D) whose training sequence (300) the receiver (UE) does not identify.

1

METHOD OF IDENTIFYING INFORMATION ADDRESSED TO A USER IN A COMMUNICATION SYSTEM, AND A COMMUNICATION SYSTEM

FIELD OF THE INVENTION

The invention relates to a method of identifying information ad-
5   dressed to a user in a communication system, the method comprising trans-
mitting, on a shared channel on which two or more receivers receive, data
packets provided with a training sequence, and generating a channel estimate
in a receiver on the basis of the training sequence.

The invention also relates to a communication system, comprising
10 at least one transmitter and at least one receiver, in which communication sys-
tem the transmitter is arranged to transmit on a shared channel data packets
provided with a training sequence, on which channel two or more receivers are
arranged to receive said data packets, and the receiver is arranged to gener-
ate a channel estimate on the basis of the training sequence.

15 BACKGROUND OF THE INVENTION

Digital radio systems offer users versatile services that require that
the radio system be able to transfer speech and data at high rates. The nature
of most services is still such that the need for data transmission is greater in
the downlink direction, i.e. from the radio system to a terminal, such as when
20 Internet-based browsers are used. Furthermore, the nature of data services is
such that the need for data transmission is transient, and it is therefore not
advantageous to continuously reserve a high capacity for a user from the point
of view of efficient utilization of the resources of the radio system.

The duplex method TDD (Time Division Duplex) used in digital radio
25 systems is a partial answer to the needs of the type described above and
caused to a radio system by data traffic. In TDD systems, the uplink and
downlink directions are separated from each other in time, and operate in the
same frequency range. In some TDD-based systems, the borders between the
transmission directions are not exactly defined, but more radio resources, such
30 as timeslots, can be allocated to for example the downlink direction, if re-
quired. Furthermore, digital radio systems comprise various channels reserved
for different purposes. Some channels are called dedicated channels, whereby
data transmission resources, such as a given combination of a radio fre-
quency, a timeslot and a spreading code, are reserved for data transmission
35 between the radio network and a terminal. Some channels, in turn, are com-

mons channels, whereby no data transmission resources are reserved between the radio network and a terminal, but all terminals can listen to all channels. In this case the radio system may comprise, for example, a common traffic channel shared by several users, on which a terminal can receive informa-

5 tion at the same time as the terminal communicates in the radio network on a dedicated channel. A shared channel is particularly well suitable for use for data traffic, since it allows the capacity offered by a dedicated channel having a low data transmission capacity to be increased.

In some digital radio systems, information to be transmitted on radio

10 channels is arranged into bursts, which are information packets in a specified format. An alternative to traffic in bursts is continuous transmission on a radio channel in a radio system. Depending on the channel, the information to be transmitted in bursts may contain either user data or control information associated with the use of the radio system; often both. The structure of a normal

15 burst, used for example in data transmission, is such that in the middle the burst comprises a training sequence composed of a number of predetermined symbols known to the terminal. On both sides of the training sequence are data periods, and the burst further comprises guard periods for separating the burst from other bursts. The receiver compares the received training sequence

20 with a known training sequence, and, on the basis thereof, is able to better demodulate the received signal. It is also known to insert into the burst an indicator of the length of a few data elements, such as a TFCI (Transport Format Combination Indicator), to supply the terminal with information on the use of the radio network, such as user bit rate. The TFCI indicator further allows for

25 example the receiver of a burst to be indicated on a shared channel. Another way to transmit control information of the above type to a terminal is to use a control channel reserved for that purpose.

However, known methods have drawbacks. The use of TFCI indicators of the length of some bits is not necessarily adequate to reliably transmit

30 to a user the required control information, because of interference at the radio interface. The use of TFCI bits in bursts further decreases the data transmission capacity of the system, since there is less space for actual user data in the bursts. The use of higher-level signalling for transmitting control information also takes up system capacity, since the control signals to be transmitted

35 through the system require measures of several sub areas of the radio system.

3

BRIEF DESCRIPTION OF THE INVENTION

It is an object of the invention to provide an improved method and apparatus for identifying information addressed to a user in a communication system. This is achieved by the method of identifying information addressed to
5   a user in a communication system, to be described next. In the method, data packets including a training sequence are transmitted on a shared channel on which two or more receivers receive, and a channel estimate is generated in the receiver on the basis of the training sequence. In the method, data packets addressed to different receivers or receiver groups are provided with different
10   training sequences, identified as data packets addressed to the receiver, and those received data packets whose training sequence the receiver identifies are further processed in the receiver, and the data packets whose training sequence the receiver does not identify are ignored in the receiver.

The invention further relates to a communication system comprising
15   at least one transmitter and at least one receiver, in which communication system the transmitter is arranged to transmit on a shared channel data packets including a training sequence, on which channel two or more receivers are arranged to receive said data packets, and the receiver is arranged to generate a channel estimate on the basis of the training sequence. The communica-
20   tion system is arranged to provide the data packets addressed to different receivers or receiver groups with different training sequences, the receiver is arranged to identify and further process the data packets addressed to the receiver and whose training sequence the receiver identifies, and the receiver is arranged to ignore the data packets whose training sequence the receiver
25   does not identify.

It is an object of the invention to eliminate problems associated with the use an indicator or with system level signalling in assigning data of a shared channel to the right user. The basic idea of the invention is to use a training sequence in a burst to identify a receiver on a shared channel in a
30   communication system.

In digital mobile communication systems, in which information to be transmitted on the radio path is encrypted by a spreading code known to the transmitter and the receiver, preferably only one spreading code in used on a shared channel. However, the invention is not restricted thereto, but even if
35   the shared channel uses several spreading codes, the receiver identifies the information addressed to it by means of the training sequence.

4

The invention provides a plurality of advantages. In bad reception conditions on a radio channel the contents of the information received can be relied on with a higher certainty, since the training sequence is used on a shared channel to identify bursts addressed to a user, and since the training

5   sequence is in practice longer than the indicator field in a burst. It is also advantageous to use the training sequence to identify a burst, since because no burst symbols have to be used in the indicator field, the data parts of a burst can be longer compared with a situation in which the indicator field in a burst is reserved for indicating to which user the burst is addressed.

10   When the quality of a channel is estimated by means of the training sequence, in the estimation a threshold value, which is obtained by known methods, is preferably used. A threshold value for channel quality is preferably generated by means of data packets to be transmitted on a channel dedicated to a user. In accordance with a preferred embodiment of the invention, a dedi-

15   cated channel is allocated to a user simultaneously with a shared channel. In this case, the disturbances the data transmitted on the dedicated channel is subjected to are a good point of comparison to the disturbances on the shared channel. The terminal estimates a received burst by reading the data contents of the burst in case the channel estimate calculated for the received burst ex-

20   ceeds the threshold value. If the channel estimate is below the threshold value, the received burst is not read, i.e. it is ignored. As an additional filter for the received bursts, the CRC (Cyclic Redundancy Test) can be performed on the received bursts in addition to the aforementioned threshold value test, whereby the certainty that the burst was intended for the user is still higher.

25   In accordance with an embodiment of the invention, the training sequence that the receiver is to use when identifying data packets transmitted on a shared channel is delivered to the terminal before the traffic intended for the terminal starts on the shared channel. The training sequence is preferably transmitted to a mobile phone at the set-up stage of a dedicated connection.

30   In this case, for example a training sequence to be transmitted on a dedicated channel and a training sequence to be transmitted on a shared channel are signalled to the user on for example a control channel FACH (Forward Access CHannel). It is also feasible that the same training sequence is used on both the dedicated and the shared channels.

35   The invention is preferably applicable in a mobile communication system using the time and code division multiple access method, such as the

5

UMTS (Universal Mobile Telephony System). The invention is particularly us-
able in a cellular radio network employing the TDD (Time Division Duplex),
without, however, being restricted thereto. It is the basic idea of the invention
that the same training sequence is used in several bursts to be sent in each
5   timeslot, whereby all bursts are addressed to a given user. This provides the
advantage that a user's data transmission capacity can be temporarily signifi-
cantly increased. Furthermore, the invention is preferably applicable in point-
to-multipoint type of broadcast, in which a radio network transmits the same
training sequence to several users, and several users receive the same infor-
10   mation.
            The invention will be described more closely in connection with pre-
ferred embodiments with reference to the attached drawings, in which
            Figure 1A schematically shows the UMTS mobile telephone system,
            Figure 1B shows the UMTS mobile telephone system described by
15   means of the GSM network,
            Figure 2 shows the structure of a protocol stack used at the radio
interface of the UMTS mobile telephone system,
            Figure 3A shows the implementation of a channel in a mobile tele-
phone system on the physical level,
20   Figure 3B is a flow chart showing the use of the training sequence
of a burst for the inventive idea,
            Figure 4 shows the spreading and modulation performed in a
transmitter,
            Figure 5 shows the inventive solution for a combined descrambling,
25   despreadcoding and demodulating block of the receiver shown in Figure 4.
            In the context of the present invention, a communication system re-
fers to for example the public land mobile network PLMN, represented by for
example the second generation digital mobile communication system GSM
(Global System for Mobile Communication) and the third generation mobile
30   communication system UMTS, which is being standardized. In addition to the
aforementioned mobile communication systems, a communication system may
comprise parts of fixed telecommunication networks, such as the PSTN (Pub-
lic Services Telephone Network). A shared channel in a communication sys-
tem refers to a traffic or control channel on which several receivers of data can
35   communicate simultaneously. In mobile communication systems, a receiver
refers in practice to a terminal comprising means for transmitting and receiving

6

information in the system. A terminal, in turn, is for example a mobile tele-
phone, a computer or other device comprising the aforementioned functional-
ities.

5   In digital mobile communication systems, information is often trans-
mitted in data packets of a specified form, which are placed in bursts transmit-
ted on the radio path. In addition to actual data addressed to a user, the bursts
also contain other data parts. For example in the GSM and UMTS systems,
the interference experienced by a user in channel signalling is estimated by
means of the training sequence included in the burst. The training sequence is
10   a number of symbols, which are known to the transmitter and the receiver and
by means of which the receiver is able to determine the distortion caused to
the information by the transmission path and to use the distortion information
to correct the data, if required.

DETAILED DESCRIPTION OF THE INVENTION

15   The invention is preferably usable in different mobile telephone sys-
tems employing the time and code division multiple access method
(TDMA/CDMA). The examples describe the use of the invention in a universal
mobile telephone system using a broadband code division multiple access
method implemented by the direct sequence technology, without, however,
20   restricting the invention thereto. Accordingly, the IMT-2000 mobile telephone
system developed by ARIB (Association of Radio Industries and Businesses)
in Japan, and the universal mobile telephone system (UMTS) developed in
Europe are systems according to the invention. The examples are based on a
description of the WCDMA system, on which additional information can be
25   found in the ETSI (European Telecommunications Standards Institute) specifi-
cation 'The ETSI UMTS Terrestrial Radio Access (UTRA) ITU-R RTT Candi-
date Submission (Tdoc SMG2 260/98, May/June 1998)', which are incorpo-
rated herein by reference. The radio network part of the UMTS operates in two
modes, FDD (Frequency Division Duplex) and TDD (Time Division Duplex).
30   FDD employs a paired frequency band, in which different frequency ranges
are defined for the uplink and downlink directions. TDD operates on one fre-
quency band, in which the uplink and downlink directions utilize the same ra-
dio frequency, but different timeslots within said frequency range.

Referring to Figures 1A and 1B, the structure of a universal mobile
35   telephone system will be described. The figures show only the blocks relevant

to the invention, but it is obvious to a person skilled in the art that a conventional mobile telephone system also comprises other functions and structures, which need not be described herein. The main parts of a mobile telephone system are a core network CN, the UMTS terrestrial radio access network

5   (UTRAN) and user equipment (UE). The interface between the CN and the UTRAN is called Iu, and the air interface between the UTRAN and the UE is called Uu. All functionality connected with a radio connection and the mobility of the UE on cell level is performed at the UTRAN. No dedicated radio connection exists to the UE; the registration stages caused by the mobility of the UE

10   are carried out in the CN.

        The UTRAN is composed of radio network subsystems (RNS). The RNS can be further divided into serving RNSs (SRNS) and drifting RNSs (DRNS), which offer radio resources to the UE via the SNRS, when required. The interface between the RNSs is called Iur. The RNS is composed of a radio

15   network controller RNC, which is in charge of the handover decisions caused by the mobility of the UE. The RNC, in turn, communicates via the interface Iub with one or more nodes B, i.e. a base stations, which are also functionally under the RNS. The coverage area, i.e. cell, of node B is denoted by C in Figures 1A and 1B.

20   As the presentation in Figure 1A is very abstract, it is clarified in Figure 1B by showing the parts of the GSM system that approximately correspond to the parts of the UMTS. It is clear that the presented mapping is by no means a binding one but an approximation, because the responsibilities and functions of the parts of the UMTS are still being planned.

25   In accordance with Figure 1B, a circuit-switched connection can be set up from the UE to a subscriber terminal 100 connected to the public switched telephone network PSTN 102. The UE can be for example fixed, vehicle-mounted or a portable mobile telephone. The base station B comprises a multiplexer 114, transceivers 116, and a control unit 118, which controls the

30   operation of the transceivers 114 and the multiplexer 116. The multiplexer 116 serves to place the traffic and control channels employed by a plurality of transceivers 114 onto a link Iub, which is the interface between the base station B and the RNC. There is a connection from the transceivers 116 of the base station B to an antenna unit 120 for implementing a bi-directional radio

35   connection Uu to the UE. The structure of the frames transmitted on the bi-directional radio connection Uu is precisely defined.

The base station controller RNC comprises a group switch field 110 and a control unit 112. The RNC typically manages the following: radio resources, control of handover between cells, power control, timing and synchronization, paging of terminals. The group switch field 110 is used for

5   switching speech and data, and for combining signalling circuits. The base station system constituted by the base station B and the base station controller RNC additionally comprises a transcoder 108. The distribution of work and the physical structure between the RNC and the base station B can vary depending on the implementation, but typically the base station B attends to the im-

10   plementation of the radio path in the aforementioned manner. The transcoder 108 is usually located as close to a mobile switching centre 106 as possible, since this allows speech to be transmitted in the form of the mobile telephone system between the mobile telephone centre 106 and the RNC, thus saving transmission capacity. The transcoder 108 converts the different digital coding

15   forms for speech employed between a public telephone network and a radio telephone network so as to make them compatible, for example the 64-kbps format used in a cellular radio network to another (for example 13-kbps) form, and vice versa. The equipment required is not described herein, but it may be stated that only speech, and not other data, is converted in the transcoder

20   108. The control unit 112 attends to call control, mobility management, collection of statistics, and signalling. The core network CN is composed of the infrastructure of the mobile telephone system, which is not part of the UTRAN. Out of the devices in the core network CN, Figure 1B illustrates the mobile switching centre 106 and a gateway mobile switching centre 104, which han-

25   dles mobile telephone system connections to a telecommunication network outside the mobile telephone system, in this case to the public telephone network 102. The CN sees to the UE's mobility management via the UTRAN when there is no dedicated data transmission resources or connection reserved for user data transmission.

30   Referring next to Figure 2, the structure of the radio interface Uu is a three-layer protocol stack, whose layers include a physical layer L1, a data link layer L2 and a network layer L3. Layer L2 is further divided into two sublayers, LAC (Link Access Control) and MAC (Medium Access Control). The network layer L3 and the LAC are further divided into control (C) and user (U)

35   levels. The physical layer L1 offers information transmission services to transport channels MAC and to higher levels. Layer L2/MAC, in turn, transmits in-

formation between the physical transmission channels and the logical channels higher in the protocol stack. Referring to Figure 2, it may be stated by way of example, that the logical control channel BCCH (Broadcast Control Channel) is implemented on the transmission channel BCH, the logical traffic channel DSCH is implemented on the transmission channel DSCH and the logical control channel FACH is implemented on the transmission channel DSCH.

Transmission channels are divided into dedicated and common channels. A user using a dedicated channel is identified by means of the physical channel, whereby, for example in the UTRAN TDD mode, a timeslot in the physical channel corresponds to a user. On a common channel, which may be used simultaneously by several users, other methods have to be used for user identification, such as using the TFCI field in a burst to be transmitted on a physical channel or by indicating the users by means of higher-level signalling.

In the following, transmission channels and physical channels will be described on the basis of the UTRAN FDD mode, without, however, being limited thereto. Table 1 shows the mapping of transmission channels to physical channels.

Transmission channel	Physical channel
BCH	Primary CCPCH
FACH	Secondary CCPCH
PCH, RACH, FACH	PRACH
DCH, PCH, FAUSCH	DPDCH, DPCCH, SCH
DSCH	PDSCH
DSCH control channel	PSCCCH, AICH

Table 1. Location of transmission channels on physical channels

There is only one type of dedicated transmission channel, a dedicated channel DCH. The DCH is used for both the uplink and downlink direction for transmitting user and control information between the network and the UE. There are several types of common transmission channels: a broadcast channel BCH is used in the downlink direction to transmit to the terminals information on cells; on a paging channel PCH, location information is inquired of a terminal when the system is unaware of the location of the terminal; on a forward access channel FACH, information is transmitted to a terminal when

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the base station knows the location of the terminal; on a random access channel RACH, a terminal may transmit uplink control information regarding for example the set-up of a connection; on a synchronization channel SCH, the system can transmit synchronization information to the terminals; on a downlink
5   shared channel DSCH, data can be transmitted to several UEs sharing the same channel; on a downlink shared channel control channel DSCH, control information regarding the use of the DSCH can be transmitted to a UE operating on the DSCH. The invention is not limited to which control channel is associated with the use of the DSCH, but all the same, a control channel preferably
10 exists. It is feasible that the system has for example no DSCH control channel at all, but the signalling associated with the use of the DSCH is attended to for example on the logical control channel FACH at the set-up stage of a connection or on the logical dedicated traffic channel DCH during the connection. In this example, signalling associated with the use of the DSCH means for example that the terminal is informed about the chance to use a shared channel.
15 ample that the terminal is informed about the chance to use a shared channel. Furthermore, in accordance with the invention, pilot symbols, by means of which a terminal identifies the bursts addressed to it on the DSCH, are preferably signalled to the terminal on the control channel.

Referring still to Table 1, the physical channels corresponding to the
20 above-described transmission channels are described in the right-hand column of the table. Two dedicated physical channels, DPDCH (Dedicated Physical Data Channel) and DPCCH (Dedicated Physical Control Channel), are defined in the uplink direction. The uplink DPDCH is used to transmit data that is generated on layer L2 and upper, whereas the DPCCH is used to transmit
25 control information generated on layer L1. In addition, one common physical channel, PRACH (Physical Random Access Channel) has been defined in the uplink direction and is used to transmit information associated with the RACH transmission channel. Only one dedicated physical channel is defined in the downlink direction, the downlink dedicated physical channel DPCH. Compared
30 with uplink, where there are two dedicated physical channels, the downlink DPCH can be considered to be a time multiplexed combination of a downlink DPDCH and DPCCH. In the downlink direction, two physical channels are defined, a primary CCPCH (primary Common Control Physical Channel) and a secondary CCPCH (secondary Common Control Physical Channel). The pri-
35 mary CCPCH transmits information of the BCH transmission channel, and the CCPCH transmits information of the FACH transmission channel.

The frame and burst structures used on physical channels differ from each other depending on which physical channel the transmission is carried out on. Referring to Figure 3A, the frame structure of the UTRA TDD mode PDPCH physical channel will be explained by way of example. Frames 340A to 340D are sequentially numbered from one to 72, and they form a 720-ms long super frame. The length of one frame, for example 340C, is 10 ms. Frame 340C is divided into sixteen timeslots 330A to 330D, each of which, for example 330C, has a 0.625-ms long timeslot. Each timeslot can be allocated simultaneously to several different users, and therefore spreading codes are used to separate the users. A data packet to be transmitted in timeslot 330C is called a burst, and the burst contains 2560 chips. According to the spreading codes, the bursts of one timeslot can be addressed to different users, but all of them can also be directed to the same user. Up to eight bursts can be placed in one uplink timeslot if the bursts are intended for different users. Up to 9 or 10 bursts can be placed in one downlink timeslot. Two structurally different burst types, burst#1 and burst#2, have been defined for the DPCH channel. In the burst of Figure 3A, which is of the type burst#2, chips 0 to 1103 contain data, chips 1104 to 1359 contain a midamble, chips 1360 to 2463 again data, and at the end of the burst is a 96-chip long guard period. A burst having such contents can be used on a downlink channel, for example. The middle of a burst used on an uplink channel is usually longer to facilitate the sorting of bursts coming from different users to a base station.

TFCI information can be sent in both burst types, burst#1 and burst#2. The network and the terminal agree upon the use of TFCI in bursts at the set-up stage of a call, but it can also be agreed upon during an ongoing call. The terminal and the network may also decide upon the number of bits to be reserved for TFCI on both sides of the midamble. TFCI information is sent to all users once per frame, and TFCI is spread using the same spreading code as in the data parts of the burst.

In the solution of the invention, TFCI indicators are not used around pilot symbols in bursts on a shared channel in a cellular radio network, but the users are distinguished on the basis of different training sequences. A training sequence used on a shared channel is signalled in user data on a dedicated traffic channel DCH, a downlink access channel FACH, or on some other channel. It is not relevant to the invention on which channel the training sequence used on a shared channel is signalled to the user, but it is essential

12

that there exists some other channel on which said control information is transmitted to the terminal.

In an embodiment the solution of the invention is used in a cellular radio network employing the time division multiple access method, which al-

5　lows several bursts to be sent in one timeslot. However, preferably the same training sequence is used in all the bursts sent in one timeslot of a shared channel, whereby all bursts in one timeslot are addressed to the same user. This is the case even though different spreading codes can be used in the bursts of the same timeslot. In this case the bursts are identified on the basis

10　of the training sequence.

Reference is next made to Figure 3B, which shows an embodiment of the method of the invention in the form of method steps. In the initial step 600, radio system resources are allocated to a terminal, and the terminal listens to the control channel, for example DSCH control, of a shared channel, a

15　dedicated channel reserved for the terminal, such as the DCH, a system control channel, such as the FACH or some corresponding channel. In step 602 the terminal receives one or more bursts on said control channel, in which bursts the system sends to the terminal a training sequence that the terminal is to use when identifying bursts on a shared channel, such as the DSCH. In

20　an embodiment of the invention, only one training sequence is allocated to the terminal, which it uses on both the control and shared channels. In this case the information transmitted on the control channel to the terminal states for example that the terminal should listen to a shared channel. Referring to step 604, the terminal listens to a shared channel on which the system sends to the

25　terminal a burst containing said training sequence that was transmitted on a control channel. On the basis of the training sequence in the burst, the terminal generates a channel estimate, i.e. it tends to estimate how the radio path has distorted the data contents of the burst. There are several methods of checking the quality of a transmission unit and a packet. The quality of a re-

30　ceived transmission unit can be determined by generating the C/I ratio (Carrier/Interference) of the transmission unit by means of the training sequence. The quality can also be determined by studying the SIR (Signal Interference Ratio), by generating the bit error rate of the transmission unit, or by studying the ratio of chip energy to disturbance power frequency E_c/I_0. These are ex-

35　amples of determining the quality of a transmission unit or a packet; however, any other known method of measuring the quality can be used. A threshold

value for the quality of a connection can be generated by any of the methods described or any corresponding method preferably by means of the control channel in use. The use of a control channel in generating the threshold value is not necessary; some predetermined reference values can be used as the threshold value. In step 608, the received burst, which was generated on a shared channel, is used to compare the generated quality value with the threshold value. If the obtained quality value exceeds the threshold value, the burst is considered to have been intended for the user and the data contents of the burst are read. If the quality value is less than the threshold value, the received burst is not read. The above steps 604 to 612 are repeated as long as the intention is to read information from the shared channel, i.e. for example as long as the dedicated traffic channel is allocated to the user.

In the following, the steps related to the transmission of information to the physical channels of the radio path by means of the transmitter-receiver technology will be described by means of Figures 4 and 5. Figure 4 describes the operation of a radio transmitter/radio receiver pair on a general level. The radio transmitter may be located at a base station B or user equipment UE, and the radio receiver at the user equipment UE or the base station B. The upper part of Figure 4 shows the essential operations of a radio transmitter in such a way that the process steps of a control channel are described above and, under them, the process steps of a data channel before the channels are combined and sent to a physical channel of a radio connection. Services to be placed on a physical channel include speech, data, moving or still video image and system control channels. Different services require different source coding means, for instance speech requires a speech codec, but for the sake of clarity, the source coding means are not shown. For example the pilot bits, which form the training sequence of a burst and which the receiver uses for channel estimation and in conclusions relating to the use of the shared channel in accordance with Figure 3B, are placed on the control channel 414. User data 400 is placed on the data channel. Thus different channel coding is performed on different channels in blocks 402A and 402B. Channel coding includes for example different block codes, an example of which is a cyclic redundancy check CRC. In addition, convolution coding and its different variations, such as punctured convolution coding or turbo coding, are typically used. However, the pilot bits are not channel coded, since the intention is to find out the distortions caused to the signal by the channel. When the different channels are channel

14

coded, they are interleaved in an interleaver 404A, 404B. The interleaving serves to facilitate error correction. During interleaving, the bits of different services are mixed together in a certain manner, whereby a transient fading on the radio path does not necessarily render the transmitted information uniden-

5 tifiable. The interleaved bits are then spread by a spreading code in blocks 406A, 406B. The chips thus obtained are scrambled by a scrambling code and modulated in block 408, whose operation will be described in greater detail in Figure 5. The individual signals obtained from different channels are combined in block 408 for transmission via the same transmitter. Finally, the combined

10 signal is applied to radio frequency parts 410, which may comprise different power amplifiers and filters for restricting the bandwidth. The closed loop control employed in transmission power control usually controls the transmission power control amplifier in this block. The analog radio signal is transmitted to the radio path Uu via an antenna 412.

15 The lower portion of Figure 4 illustrates the essential functions of a radio receiver. The radio receiver is typically a RAKE receiver. An analog radio frequency signal is received from the radio path Uu by an antenna 432. The signal is applied to radio frequency parts 430 comprising a filter for blocking frequencies outside the desired frequency band. In block 428, the signal is

20 then converted into an intermediate frequency or directly into baseband, and in this form the signal is sampled and quantized. Because the signal in question is a multipath propagated signal, efforts are made to combine the signal components propagated on different paths in block 428, which, in accordance with prior art, comprises the actual RAKE fingers of the receiver. The interleaving of

25 the obtained physical channel is removed in de-interleaving means 426, and the de-interleaved physical channel is divided in a demultiplexer 424 into data streams of different channels. Each of the channels is directed to a de-channel-coding block 422A, 422B, in which the channel coding used in transmission, e.g. block coding and convolution coding, is removed. A Viterbi de-

30 coder is preferably used to decode the convolution coding. Each transmitted channel 420A, 420B can be applied to any necessary further processing, for instance data 420 is applied to a computer 122, connected to the user equipment UE and shown in Figure 1B. The system control channels are applied to a control part 436 in the radio receiver.

35 Figure 5 shows in greater detail the spreading of a channel with a spreading code and the modulation thereof. In the figure, a channel bit stream
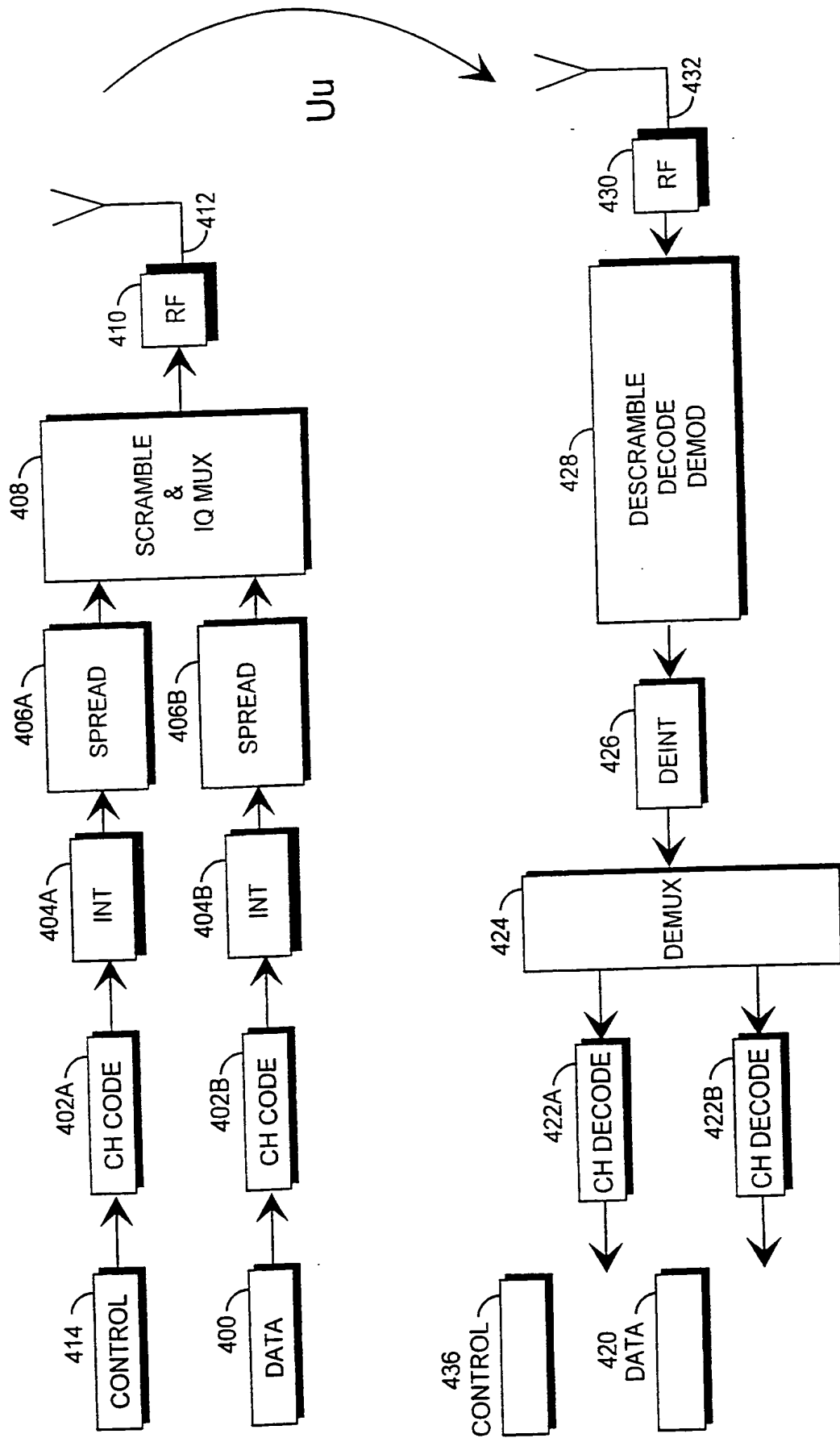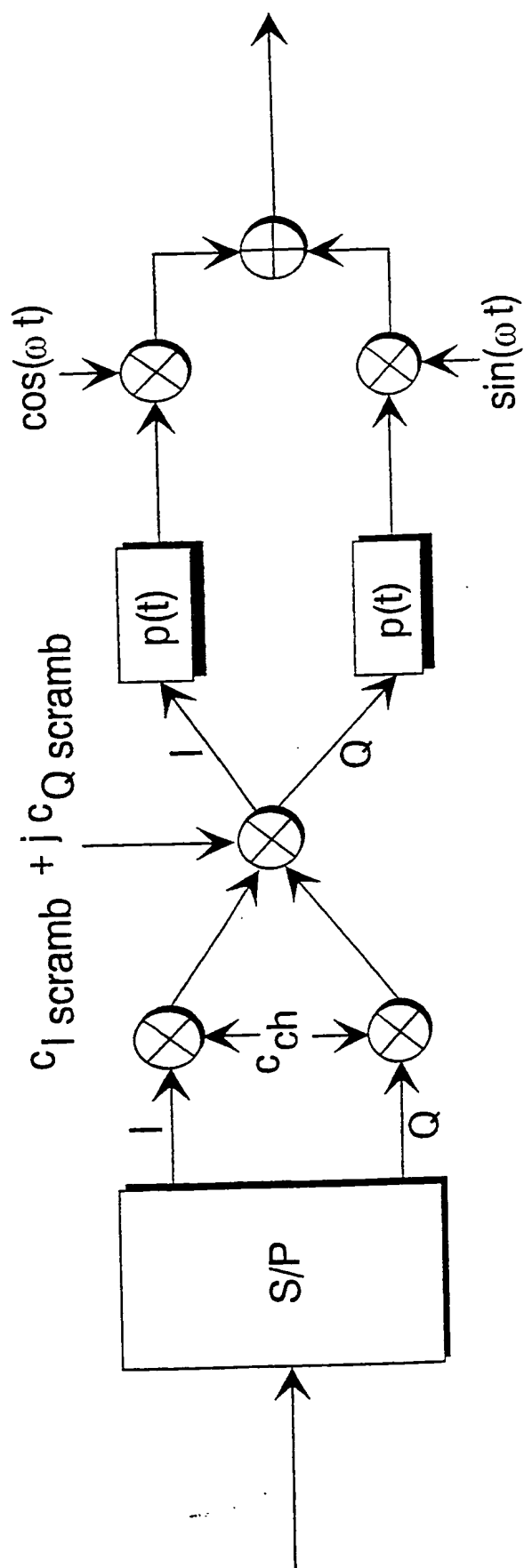
Fig 4

Fig 5

arrives from the left at block S/P, in which each two-bit sequence is converted from series form to parallel form, i.e. one bit is applied to signal branch I and the other to signal branch Q. The signal branches I and Q are then multiplied with a spreading code c_{ch}, which spreads the relatively narrowband information

5   to a wide frequency band. The spreading code can be the same or different for each branch. Each connection Uu has its own spreading code(s) with which the receiver identifies transmissions intended for it. The signal is then scrambled by multiplying it with a scrambling code $c_{I\,scramb} + j\,c_{Q\,scramb}$, which is different for each transmitter. The pulse form of the obtained signal is filtered with

10   filters p(t). Lastly, the signal is modulated to a radio frequency carrier by multiplying its different branches that are shifted from each other 90 degrees, and the branches so obtained are combined into one carrier, which can be sent to the radio path Uu, bar any filtering or power amplification. The modulation described is QPSK (Quadrature Phase Shift Keying). Instead of the I/Q multiplex-

15   ing described, time multiplexing can also be used, in which data and control channels are placed in succession in the time domain. However, in this case the time difference between the channels is so small that the interference estimated from the control channel can be assumed to be the same in the data channel, too.

20   The maximum number of different, simultaneously used, typically mutually orthogonal spreading codes is 256. For example, when a 5-MHz carrier is used at the rate 4.096 Mchps on UMTS downlink, the spreading factor 256 corresponds to a transmission rate of 32 kbps; similarly, the highest feasible transmission rate is obtained with the spreading factor 4, the data trans-

25   mission rate being 2,048 kbps. Consequently, the transmission rate on a channel varies stepwise 32, 64, 128, 256, 512, 1,024 and 2,048 kbps, the spreading factor varying similarly 256, 128, 64, 32, 16, 8 and 4. The data transmission rate available to a user depends on the channel coding used. For example, when 1/3 convolution coding is used, the user's data transmission

30   rate is about 1/3 of the data transmission rate of the channel. The spreading factor indicates the length of the spreading code. For example, spreading code (1) corresponds to spreading factor one. Spreading factor two has two mutually orthogonal spreading codes (1,1) and (1,-1). Further, spreading factor four has four mutually orthogonal spreading codes: spreading codes (1,1,1,1) and

35   (1,1,-1,-1) under an upper layer spreading code (1,1), and spreading codes (1,-1,1,-1) and (1,-1,-1,1) under a second upper layer spreading code (1,-1).

This way the generation of spreading codes continues in the code tree towards the lower levels. The spreading codes of a given level are always mutually orthogonal. Similarly, a spreading code of a given level is orthogonal to all spreading codes that are on following levels and are derived from a second
5   spreading code of the same level. In transmission, one symbol is multiplied with a spreading code, whereby the data is spread to the frequency band to be used. For example, when spreading code 256 is used, 256 chips represent one symbol. Similarly, when spreading code 16 is used, 16 chips represent one symbol.
10   Although the invention has been described above with reference to the example in the attach drawings, it is obvious that the invention is not restricted thereto, but can be modified in a plurality of ways within the scope of the inventive idea disclosed in the attached claims.

CLAIMS

1. A method of identifying information addressed to a user in a communication system, the method comprising

(604) transmitting, on a shared channel on which two or more re-
5   ceivers receive, data packets provided with a training sequence, and

(606) generating a channel estimate in a receiver on the basis of the training sequence,

c h a r a c t e r i z e d in that

data packets addressed to different receivers or receiver groups are
10   provided with different training sequences,

(610) identified as data packets addressed to the receiver, and those received data packets whose training sequence the receiver identifies are further processed in the receiver, and

the data packets whose training sequence the receiver does not
15   identify are ignored in the receiver.

2. A method as claimed in claim 1, c h a r a c t e r i z e d in that said identifying step comprises the steps of:

comparing, in the receiver, the value of the channel estimate with a threshold value measuring the quality of the channel, and
20   further processing the data packet when the value of the channel estimate exceeds the threshold value,

ignoring the data packet when the value of the channel estimate is less than the threshold value.

3. A method as claimed in claim 2, c h a r a c t e r i z e d in that
25   said channel estimate value is the signal interference ratio (SIR), the car-
rier/interference ratio (C/I), the bit error rate (BER), or the ratio of chip energy to disturbance power frequency (E_c/I_0).

4. A method as claimed in claim 1, 2 or 3, c h a r a c t e r i z e d in that the training sequence that the receiver is to use on the shared channel is
30   indicated to the receiver before handover to a shared channel.

5. A method as claimed in claim 1, 2, 3 or 4, c h a r a c t e r i z e d in that

the receiver receives time dividedly both on said shared channel and a parallel dedicated channel.

35   6. A method as claimed in claim 5, c h a r a c t e r i z e d in that the

18

parallel dedicated channel is a control channel.

7. A method as claimed in claim 5 or 6, **c h a r a c t e r i z e d** in that each dedicated channel uses a different training sequence.

8. A method as claimed in claim 5, 6 or 7, **c h a r a c t e r i z e d** in that the receiver uses on the shared channel the same training sequence as on the parallel dedicated channel.

9. A method as claimed in any one of claims 1 to 8, **c h a r a c - t e r i z e d** in that the training sequence is indicated to the receiver via a common control channel or a parallel dedicated channel before handover to the shared channel.

10. A method as claimed in claim 1 or 2, **c h a r a c t e r i z e d** in that performing a CRC (Cyclic Redundancy Check) on the accepted data packets of the shared channel before further processing.

11. A method as claimed in claim 1, 2 or 5, **c h a r a c t e r i z e d** in that the threshold value for the channel estimate is generated on the basis of a data packet received on the dedicated channel.

12. A method as claimed in any one of the preceding claims, **c h a r a c t e r i z e d** in that the communication system is a time division multiple access type of cellular radio network, and that said shared channel is a timeslot and said data packet is a radio burst to be sent in the timeslot and comprising at least said training sequence and data.

13. A method as claimed in claim 10, **c h a r a c t e r i z e d** in that the time division duplex principle (TDD) is used on the carrier on which the shared channel is.

14. A method as claimed in claim 10 or 11, **c h a r a c t e r i z e d** in that several radio bursts are simultaneously sent in a timeslot of the shared channel on the CDMA principle using different spreading codes, and that different training sequences are used in radio bursts for different receivers or receiver groups.

15. A method as claimed in claim 12, **c h a r a c t e r i z e d** in that the receiver receives simultaneously several radio bursts with different spreading codes and accepts one or more radio bursts whose training sequence it identifies.

16. A method as claimed in claim 12 or 13, **c h a r a c t e r i z e d** in that the receiver identifies a radio burst by means of both the training sequence and the spreading code.

17. A method as claimed in any one of claims 10 to 14, **c h a r a c -
t e r i z e d** in that a shared timeslot is allocated one TDMA frame at a time,
and the training sequence is used to indicate to which receiver or receiver
group the timeslot is allocated in each frame.

5   18. A communication system, comprising at least one transmitter
(120) and at least one receiver (UE), in which communication system

the transmitter (120) is arranged to transmit on a shared channel
(312) data packets (330A to 330D) provided with a training sequence (300), on
which channel two or more receivers (UE) are arranged to receive said data
10   packets (330A to 330D), and

the receiver (UE) is arranged to generate a channel estimate on the
basis of the training sequence (300),

c h a r a c t e r i z e d in that

the communication system is arranged to provide the data packets
15   (330A to 330D) addressed to different receivers (UE) or receiver groups with
different training sequences (300),

the receiver (UE) is arranged to identify and further process the
data packets (330A to 330D) addressed to the receiver (UE) and whose train-
ing sequence (300) the receiver (UE) identifies, and

20   the receiver (UE) is arranged to ignore the data packets (330A to
330D) whose training sequence (300) the receiver (UE) does not identify.

19. A communication system as claimed in claim 18, **c h a r a c -
t e r i z e d** in that

the receiver is arranged to compare the value of the channel esti-
25   mate with a threshold value measuring the quality of the channel,

the receiver is arranged to further process the data packet when the
value of the channel estimate exceeds the threshold value, and

the receiver is arranged to ignore the data packet when the value of
the channel estimate is less than the threshold value.

30   20. A communication system as claimed in claim 19, **c h a r a c -
t e r i z e d** in that said channel estimate value is the signal interference ratio
(SIR), the carrier/interference ratio (C/I), the bit error rate (BER), or the ratio of
chip energy to disturbance power frequency (E_c/I_o).

21. A communication system as claimed in claim 18, 19 or 20,
35   **c h a r a c t e r i z e d** in that the transmitter is arranged to indicate the training
sequence that the receiver is to use on the shared channel before handover to

a shared channel.

22. A communication system as claimed in claim 18, 19, 20 or 21, c h a r a c t e r i z e d in that the receiver is arranged to receive time dividedly both on said shared channel and a parallel dedicated channel.

5   23. A communication system as claimed in claim 22, c h a r a c - t e r i z e d in that the parallel dedicated channel is a control channel.

24. A communication system as claimed in claim 22 or 23, c h a r - a c t e r i z e d in that the communication system is arranged to use a different training sequence on each dedicated channel.

10   25. A communication system as claimed in claim 22, 23 or 24, c h a r a c t e r i z e d in that the receiver is arranged to use on the shared channel the same training sequence as on the parallel dedicated channel.

26. A communication system as claimed in any one of claims 17 to 25, c h a r a c t e r i z e d in that the transmitter is arranged to indicate the

15   training sequence to the receiver via a common control channel or a parallel dedicated channel before handover to the shared channel.

27. A communication system as claimed in claim 18 or 19, c h a r - a c t e r i z e d in that the receiver is arranged to perform a CRC (Cyclic Redundancy Check) on the accepted data packets of the shared channel before

20   further processing.

28. A communication system as claimed in claim 18, 19 or 22, c h a r a c t e r i z e d in that the receiver is arranged to generate the threshold value for the channel estimate on the basis of a data packet received on the dedicated channel.

25   29. A communication system as claimed in any one of the preceding claims, c h a r a c t e r i z e d in that the communication system is a time division multiple access type of cellular radio network, and that said shared channel is a timeslot and said data packet is a radio burst to be sent in the timeslot and comprising at least said training sequence and data.

30   30. A communication system as claimed in claim 29, c h a r a c - t e r i z e d in that the communication system is arranged to use the time division duplex principle (TDD) on the carrier on which the shared channel is.

31. A communication system as claimed in claim 29 or 30, c h a r - a c t e r i z e d in that the transmitter is arranged to send several radio bursts

35   simultaneously in a timeslot of the shared channel on the CDMA principle using different spreading codes, and that the transmitter is arranged to use dif-

ferent training sequences in radio bursts for different receivers or receiver groups.

32. A communication system as claimed in claim 31, **c h a r a c -**
t e r i z e d in that the receiver is arranged to receive simultaneously several

5   radio bursts with different spreading codes, and the receiver is arranged to accept one or more radio bursts whose training sequence it identifies.

33. A communication system as claimed in claim 31 or 32, **c h a r -**
a c t e r i z e d in that the receiver is arranged to identify a radio burst by means of both the training sequence and the spreading code.

10   34. A communication system as claimed in any one of claims 29 to 33, **c h a r a c t e r i z e d** in that the communication system is arranged to allocate a shared timeslot one TDMA frame at a time, and the transmitter is arranged to use the training sequence to indicate to which receiver or receiver group the timeslot is allocated in each frame.
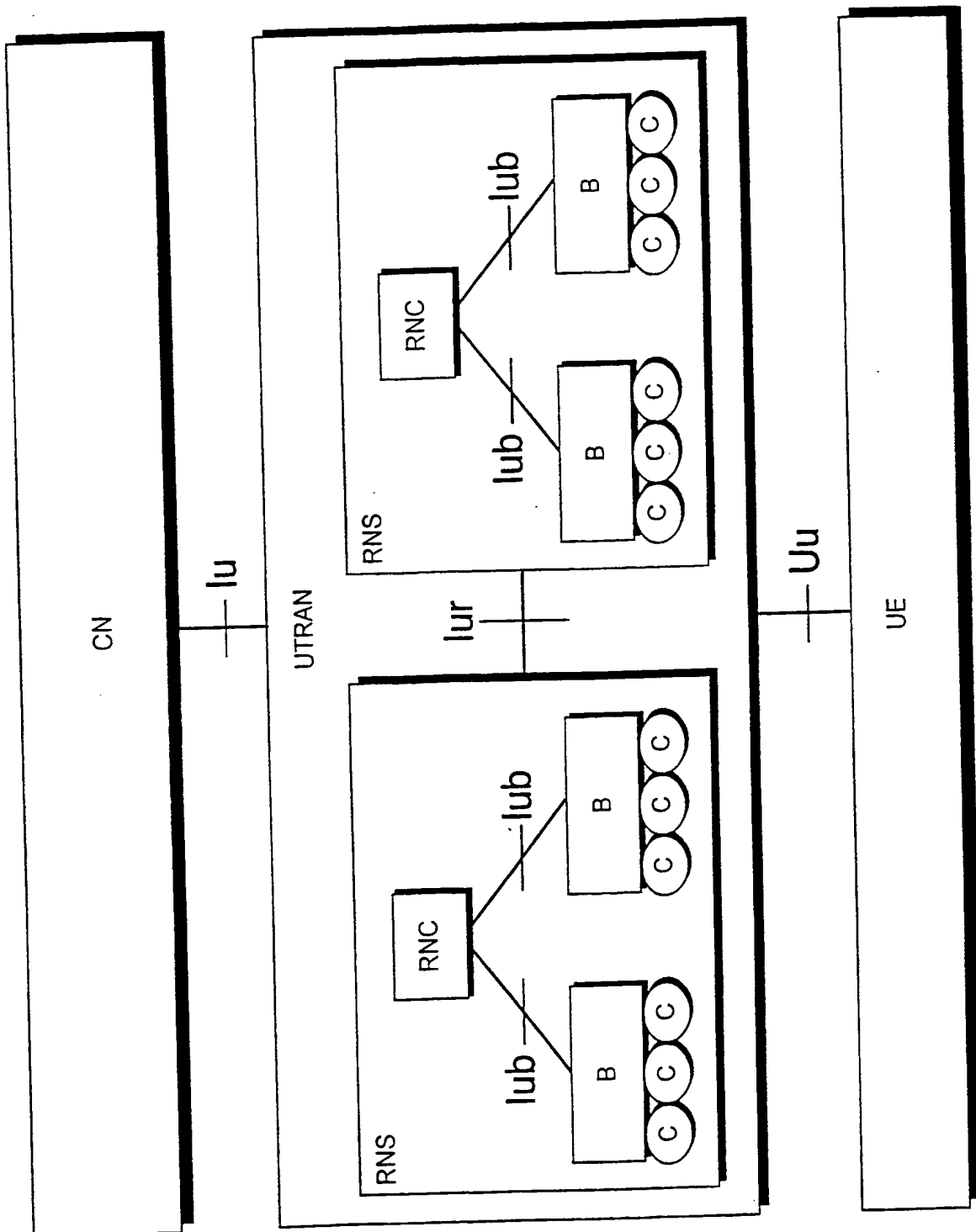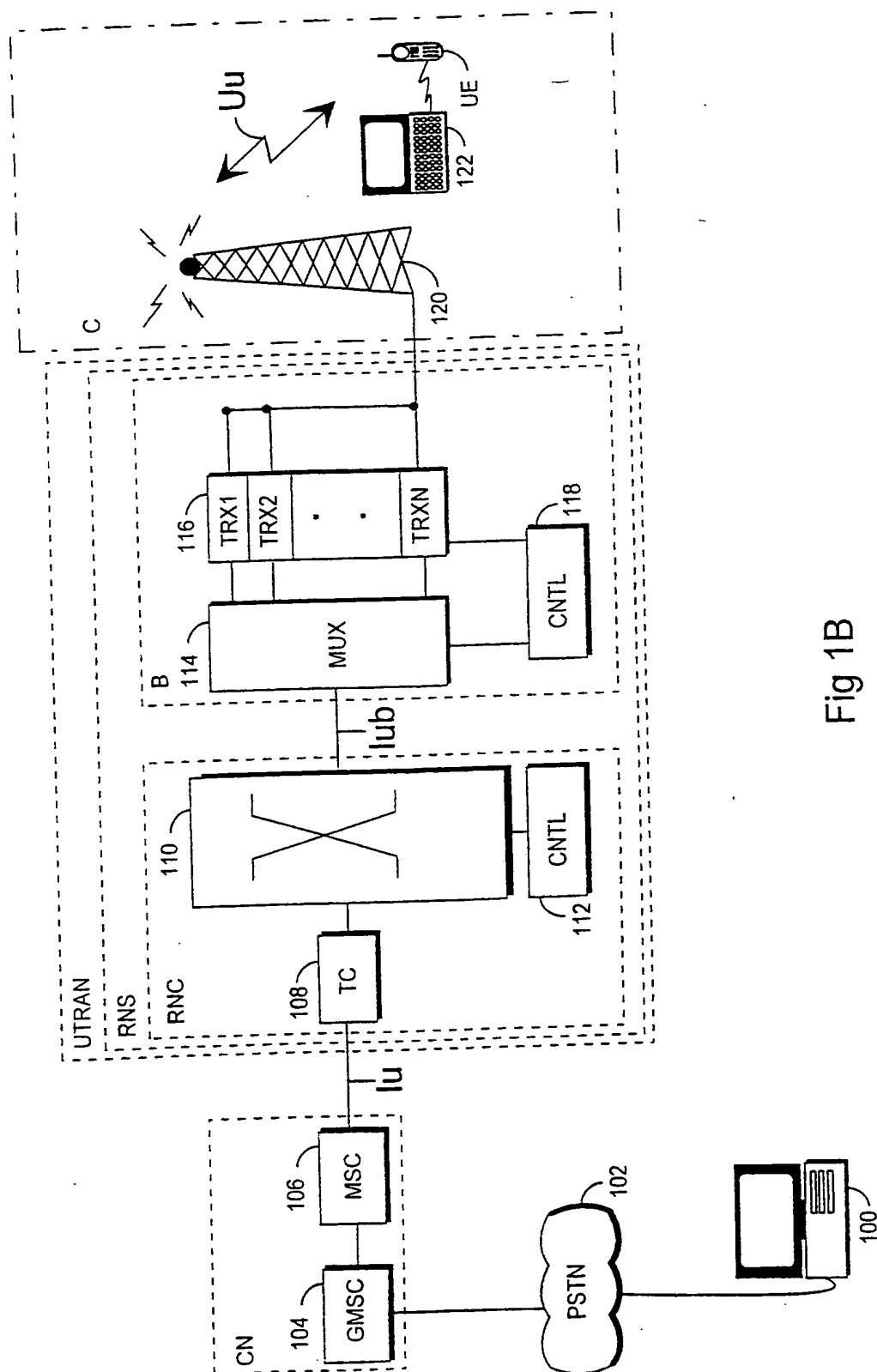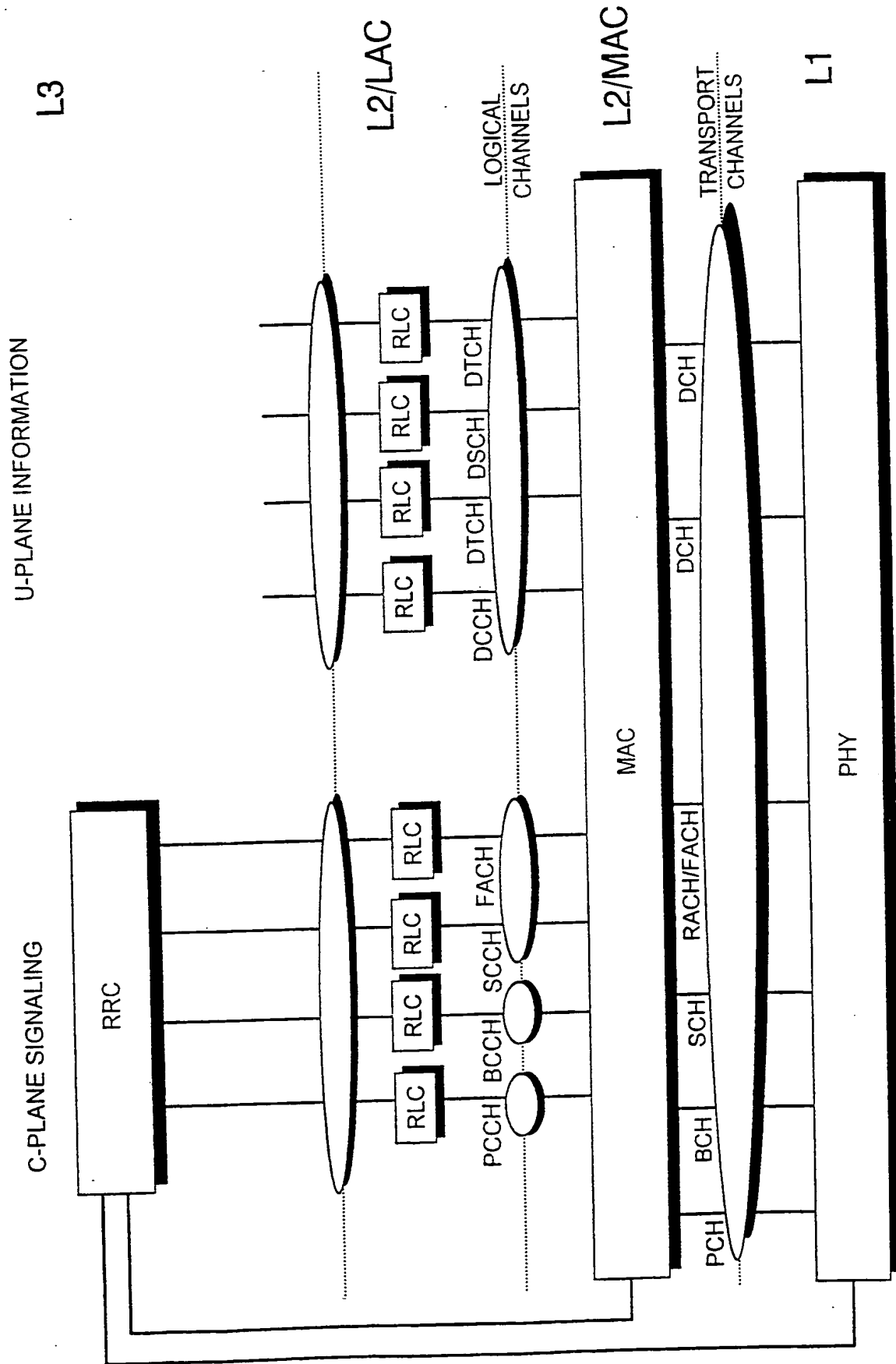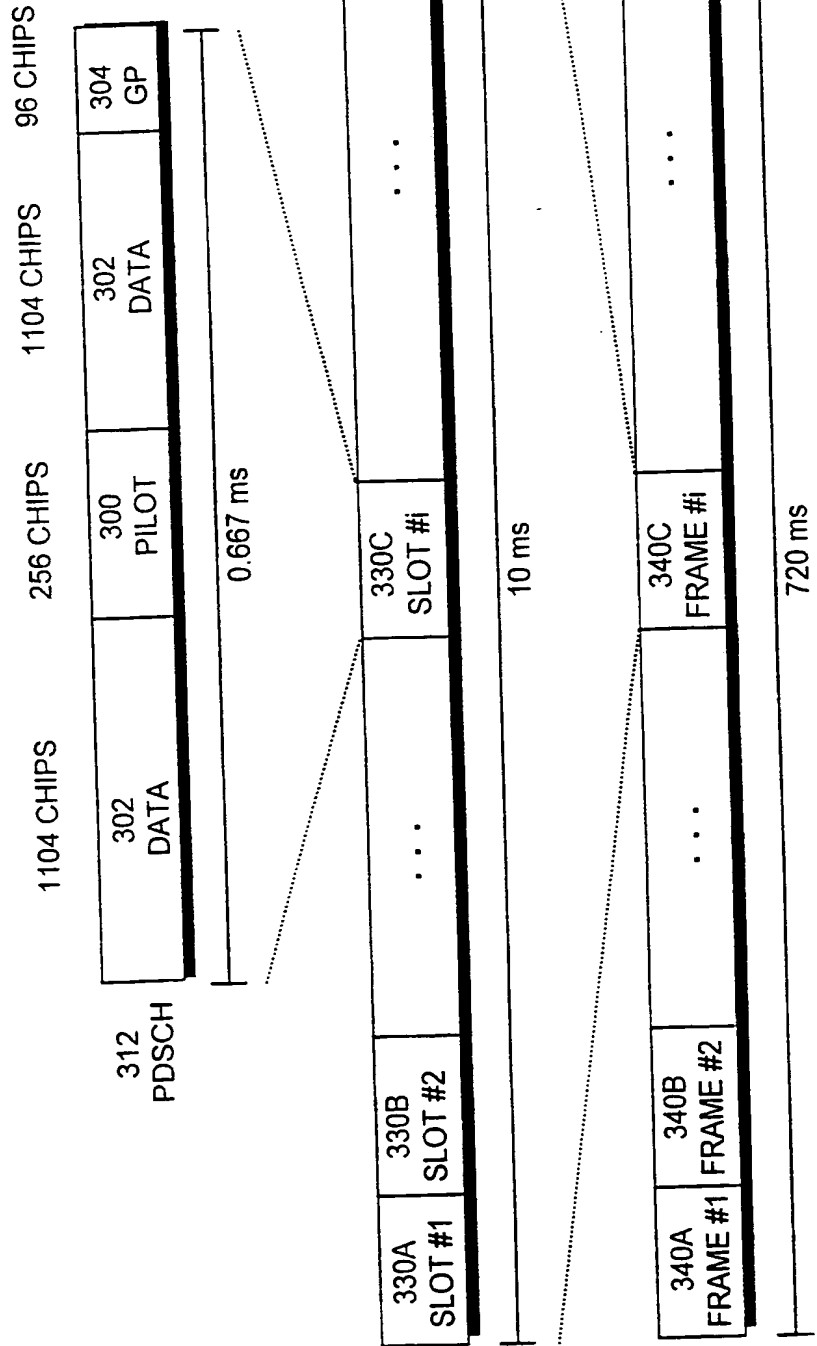
15

Fig 1A

Fig 1B

Fig 2

Fig 3A

600 START

602 SENDING ON DEDICATED CHANNEL OR CONTROL CHANNEL A BURST TO THE TERMINAL CONTAINING SECOND TRAINING SEQUENCE

604 SENDING ON SHARED CHANNEL A BURST TO THE TERMINAL CONTAINING SECOND TRAINING SEQUENCE

606 CREATING IN TERMINAL A CHANNEL ESTIMATE BASED ON SECOND TRAINING SEQUENCE OF RECEIVED BURST?

608 VALUE OF CHANNEL ESTIMATE BETTER THAN REFERENCE VALUE?

YES

NO

610 READING DATA OF BURST ON SHARED CHANNEL

612 END

Fig 3B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 00/00614

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04B 7/05, H04Q 7/38, H04Q 7/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04B, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9807291 A2 (NOKIA TELECOMMUNICATIONS OY), 19 February 1998 (19.02.98), see whole document	1,18
A	US 5905733 A (TORBJöRN WILSON SöLVE ET AL), 18 May 1999 (18.05.99), see whole document	1,18

☐ Further documents are listed in the continuation of Box C.　　☒ See patent family annex.

*　　Special categories of cited documents:

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"E" erlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search	Date of mailing of the international search report
20 October 2000	2 4 -10- 2000

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		03/10/00	International application No. PCT/FI 00/00614

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